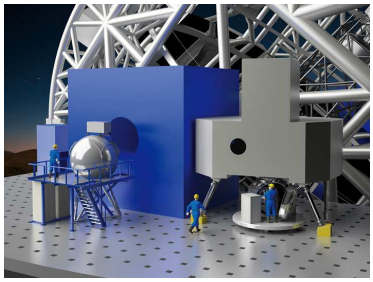
# An hybrid Laser and Natural guide stars Multiconjugate adaptive optics system for astronomy



*This module focuses on the characteristics of a mixed Natural and Laser Guide star Wave-front sensor system for Multiconjugate adaptive optics (MCAO). The MCAO was developed to provide a homogenous correction of the turbulence and the telescope aberrations over a large Field of View (FoV) of several arcmin. The dimensioning of Wavefront sensors geometry and temporal sampling of the Multiconjugate Adaptive Optics Relay (MAORY) for the Extremely Large Telescope was studied through a simulation tool which will also provide the definition of the optimal control strategy. The control aspects are the ones to be optimised to achieve the ultimate goal of the instrument. The simulation tool, written in IDL, helps to investigate the optimal configuration of the instrument and control loop parameters to maximise the performance.*

by CARMELO ARCIDIACONO, LAURA SCHREIBER, MATTEO LOMBINI, EMILIANO DIOLAITI

Contemporary astronomy pushes the development of new instruments to be larger and larger. In particular, visible and near infrared ground-based telescopes look toward a new class of extremely large telescope (ELT) with a diameter of the order of 20m and even larger. The European Extremely Large Telescope (E-ELT) will be the largest telescope on Earth and will collect images with a resolution ten times finer than the Hubble Space Telescope (HST) and even better than the forthcoming successor – the James Webb Space Telescope (JWST) –. The telescope will achieve this record thanks to the adaptive optics technique. A series of optical deformable systems counter weight the optical deformation introduced by atmospheric turbulence above the telescope restoring the original optical quality of the telescope set by diffraction theory. An adaptive optics system is mainly based on two key elements: a **wavefront sensor** that measures the optical distortion of the light above the telescope in the direction of a field of view of astronomical interest and a **deformable mirror** or more that provide the correction in the optical train before the astronomical detector module.

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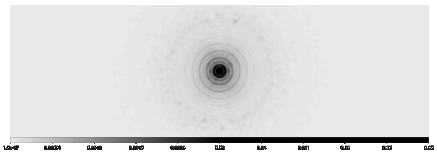

The MAORY will be the adaptive optics module of the EELT. The MAORY will provide the measurement of a constellation of artificial Laser Guide Stars to disentangle the tomographic volume of the optical turbulence above the telescope. A set of three Natural Guide Stars will simultaneously provide vibration and focus correction over the field of interest. In particular, the MAORY corrects for a field of view a bit larger than the field of view imaged by the host camera MICADO, supplying in real time the commands for the actuation of the correction through three deformable mirrors with thousands of degrees of freedom. The control of the actuation given the tomographic measurements of the optical turbulence is the main topic of the module. A numerical simulator was developed to numerically predict the performance on different atmospheric condition and brightness of the reference stars and will be used to compare the behaviour of the correction with respect to the characteristic of the key elements of the system. The main mathematical aspects behind both the adaptive optics system and the simulator will be addressed through a simple linear algebra description.

Details 1
Details 2

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